2

WATER RESOURCES DATA

2 WATER RESOURCES DATA

2.1 Surface Water Quantity Monitoring

The Department has established and operates a national surface water monitoring network along rivers, dams, estuaries, eyes, canals, and pipelines. The purpose of the national network is to monitor hydrological and hydro-meteorological conditions to enable water resource assessment, planning, water supply management, system operations, and flood forecasting. The summary structure of the surface water monitoring programme in the Department is shown in Figure 2.1. The programmes are divided into two, the first is hydro-meteorological programme which monitors evaporation and rainfall, and the second programme is hydrological monitoring which entails streamflow and dam levels monitoring.

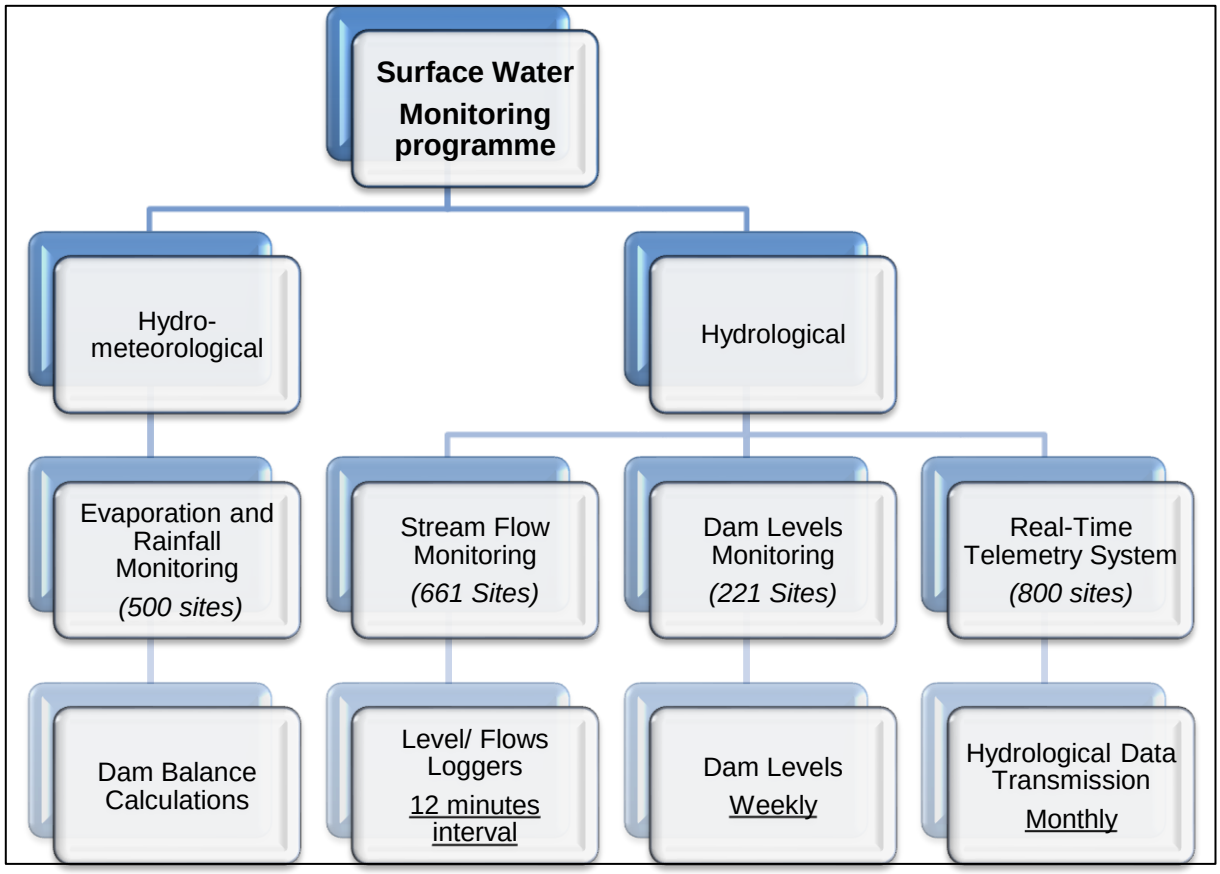


Figure 2.1: Summary structure of the surface water monitoring programmes

The DWS regional offices have selected several monitoring primary stations equipped with real-time telemetry data transmission systems. These include monitoring stations for dams, evaporation, rainfall, and streamflow. Data is transmitted from the monitoring

stations directly to the national office and DWS website in near real-time. It is made available for use by all stakeholders as unverified data.

- *Dam Levels Monitoring*

The national dam monitoring is conducted at a regional level, and the DWS regional officials collect dam gauge plate readings every Monday. Upon capturing the collected data, the national office is responsible for processing, verifying, and disseminating data to various stakeholders through a weekly dam levels bulletin and summary synopsis. The locality map of the dam levels stations nationally is presented in Figure 2.2.

- *Evaporation and Rainfall Monitoring*

Evaporation and rainfall monitoring stations are situated at dam sites. The evaporation and rainfall readings are taken daily, except for rain gauges equipped with automatic tipping buckets. Data collected from these monitoring stations are audited monthly and processed in three months at the national office.

- *Streamflow Monitoring*

Streamflow monitoring stations are managed by the regional offices and are responsible for monthly downloading data from the dataloggers. Several streamflow monitoring stations are equipped with real-time telemetry data transmission systems; data transmitted from these systems can be accessed at www.dws.gov.za/hydrology. The national surface water monitoring network for streamflow gauging stations is presented in Figure 2.3.

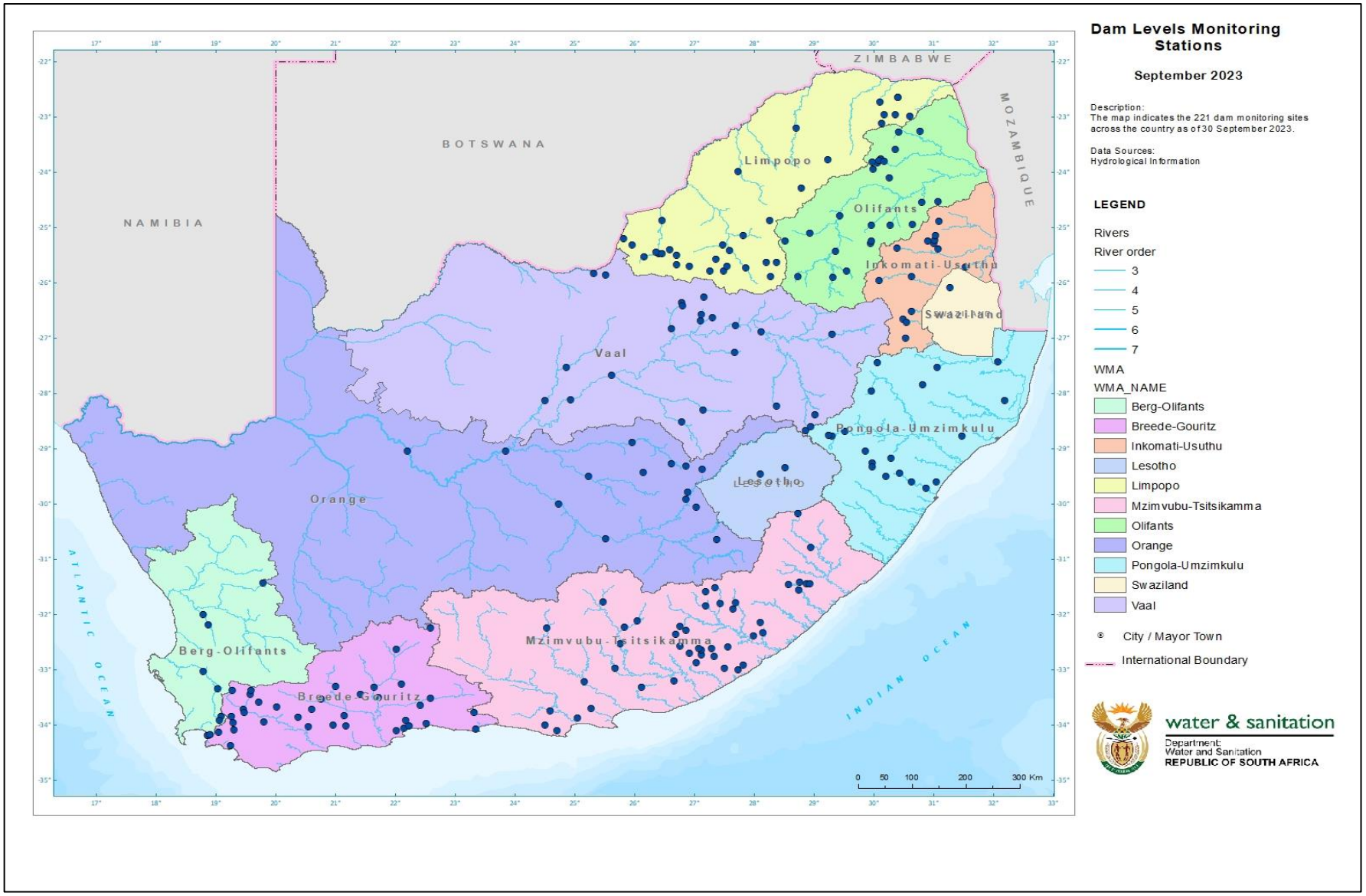


Figure 2.2: Dam levels monitoring stations network- September 2023.

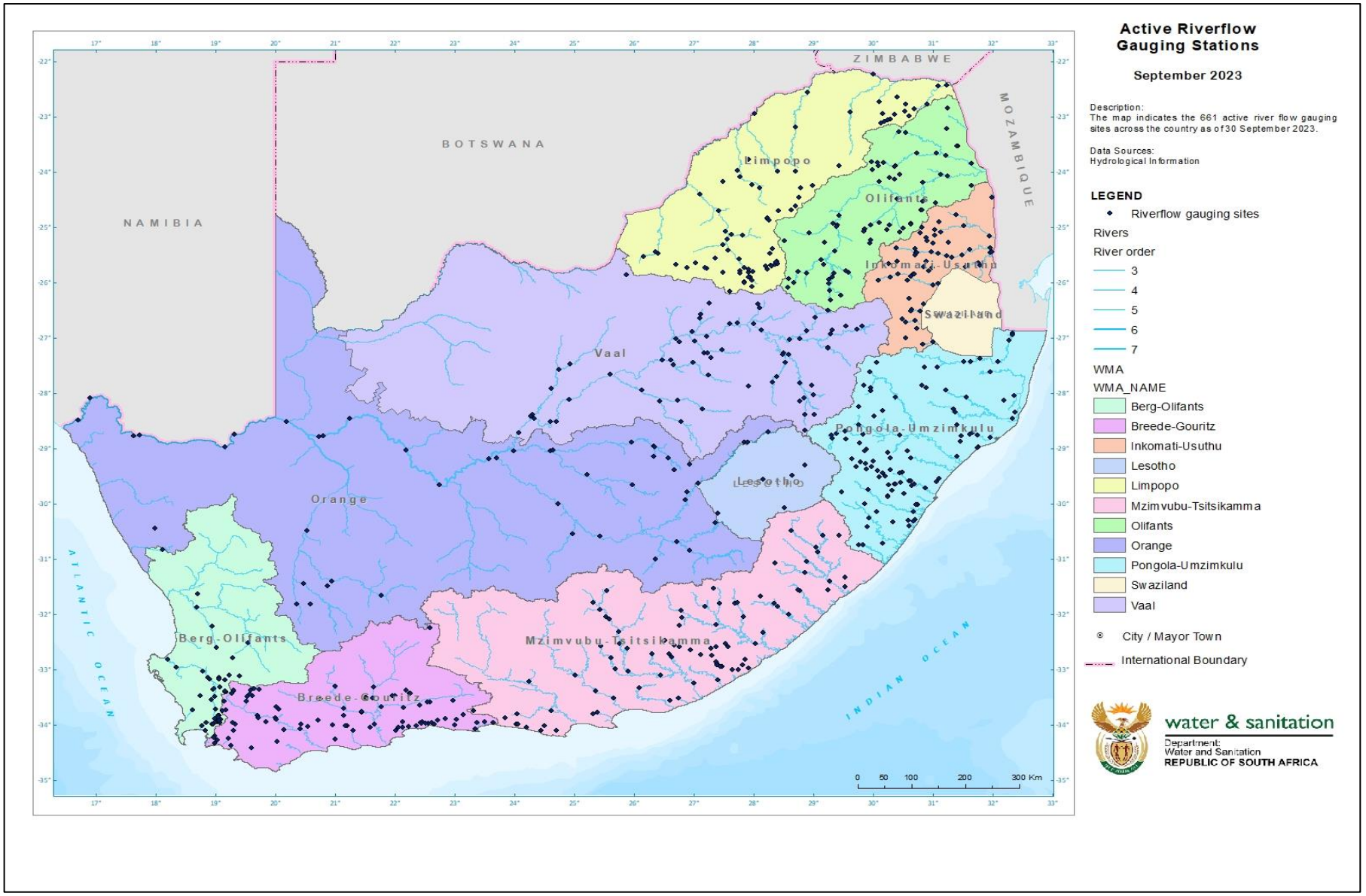


Figure 2.3: National Streamflow monitoring network - September 2023.

2.1.1 Surface Water Quantity Data Availability

The surface water monitoring network has 1450 stations across all the provinces, as shown in Figure 2.4. At the end of the current reporting period, 1123 stations were active and had data, a slight decline from the reported 1238 active stations with data at the end of the 2021/22 hydrological year. All station types across provinces had impressive data availability, with Limpopo, Western Cape, Eastern Cape, and Gauteng all having above 90% data availability at the end of the reporting period, the average national data availability across all provinces is currently at 89%.

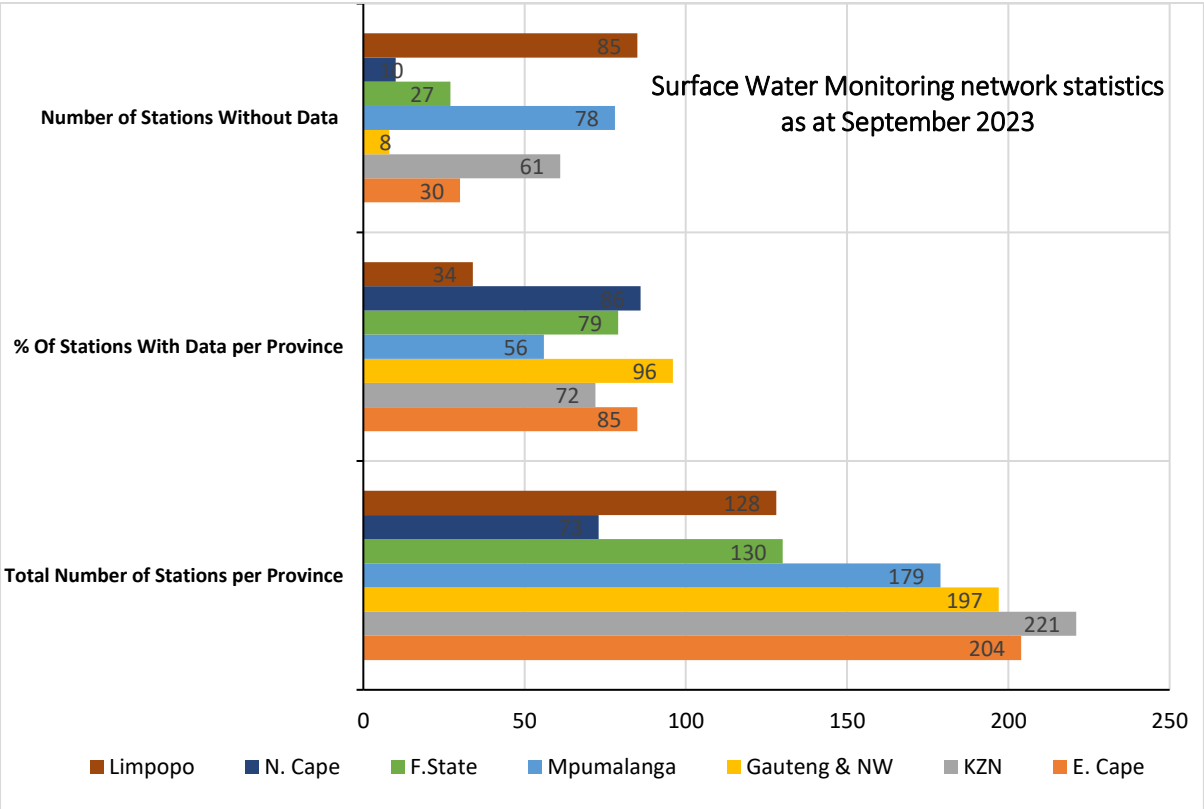
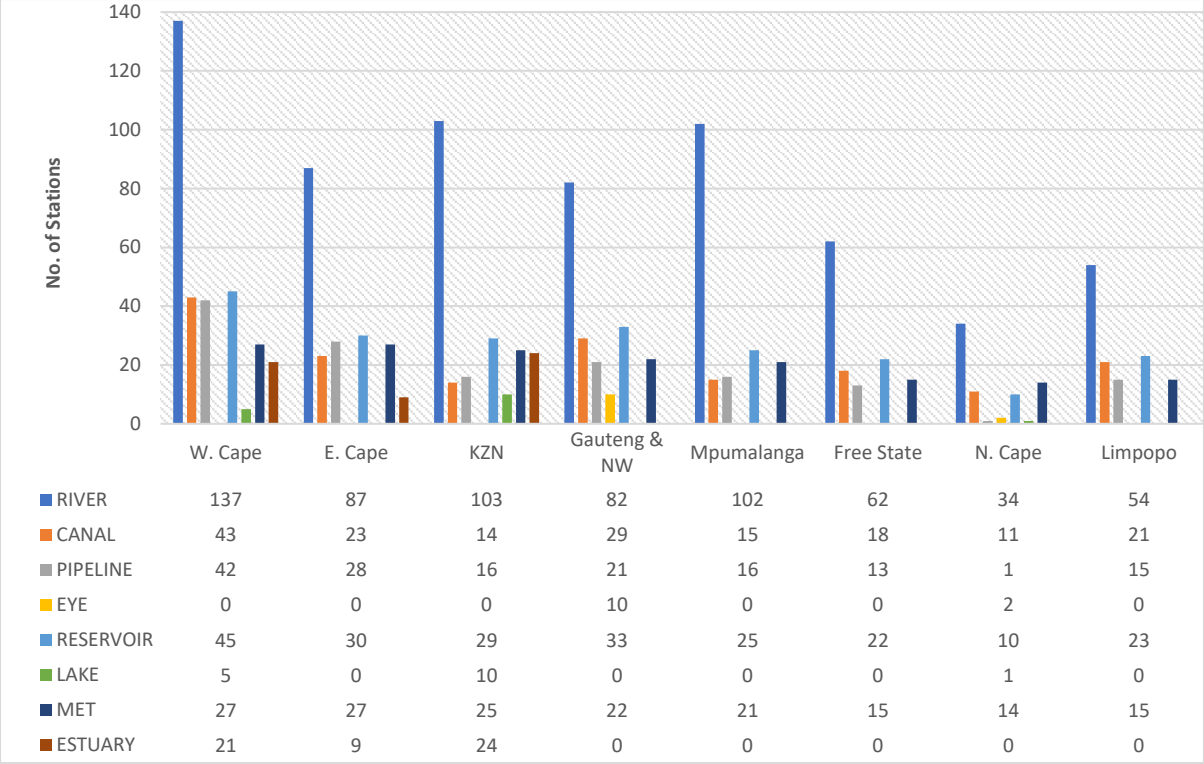


Figure 2.4: Summary of monitoring networks across South Africa as of September 2023 (extracted December 2023)

The station types per province in Figure 2.5, show a predominance of stations for river flow monitoring, most provinces reported a significant improvement in data availability compared to the previous year for river flow gauging. KZN reported 103 active stations, an increase of 23 from the previous year; and Mpumalanga increased from 63 stations with data in 2022 to 102 stations in the current reporting period. Estuaries are monitored in coastal areas, and the number of estuaries active stations in the Western Cape has increased from 10 in the 2020/21 hydrological year to 20 in the current reporting period. All provinces demonstrated a reasonable number of active stations in the reservoir monitoring, with the Western Cape and Gauteng leading, respectively.



	W. Cape	E. Cape	KZN	Gauteng & NW	Mpumalanga	Free State	N. Cape	Limpopo
RIVER	137	87	103	82	102	62	34	54
CANAL	43	23	14	29	15	18	11	21
PIPELINE	42	28	16	21	16	13	1	15
EYE	0	0	0	10	0	0	2	0
RESERVOIR	45	30	29	33	25	22	10	23
LAKE	5	0	10	0	0	0	1	0
MET	27	27	25	22	21	15	14	15
ESTUARY	21	9	24	0	0	0	0	0

Figure 2.5: Station types with available data per province as of September 2023 (extracted December 2023).

2.2 Surface Water Quality Monitoring Programmes

The Department of Water and Sanitation, as custodian of South Africa's water resources, seeks to ensure that water resources remain fit for recognised water uses while also maintaining and protecting the viability of aquatic ecosystems. As a result, several water quality monitoring programmes are currently in operation across the country. This section will outline DWS water quality monitoring programmes, their objectives, distribution, and performance during the current reporting period.

2.2.1 National Chemical Monitoring Programme (NCMP)

The NCMP provides information on the status and trends of inorganic chemical water quality in South Africa, primarily in rivers, on a national scale. It was established in the 1970s based on the information requirements and national priorities at the time and has been amended over the years to remain relevant to evolving needs. It is the longest-running South African water quality monitoring programme which has provided data and information for over 50 years for the inorganic chemical quality of surface water resources at various sites across the length and breadth of the country.

Figure 2.6 shows the location of the 341 sites that currently constitute the Priority National Chemical Monitoring Programme (PNCMP). The main objectives of this national scale programme include:

- Having sufficient inorganic water quality data available to determine the status and trends in South African rivers at a national scale;
- Supporting the National River Eco-status Monitoring Programme (REMP); the United Nations Environmental Programme – Global Environmental Monitoring System (UNEP GEMS), and Sustainable Development Goals (especially SDG 6.3) initiatives;
- Contributing to the integrated overarching historical database; and
- The dissemination of data and information.

The NCMP monitoring sites are primarily located at the downstream end of each tertiary drainage region as a descriptor of that drainage region's impact on water quality. Sites are also chosen based on strategic significance, such as interactions with neighbouring countries or participation in the UNEP GEMS, and Sustainable Development Goals (SDG) initiatives, specifically SDG 6.3.2 on Ambient Water Quality. Where possible, site selection aims to preserve long and consistent data records.

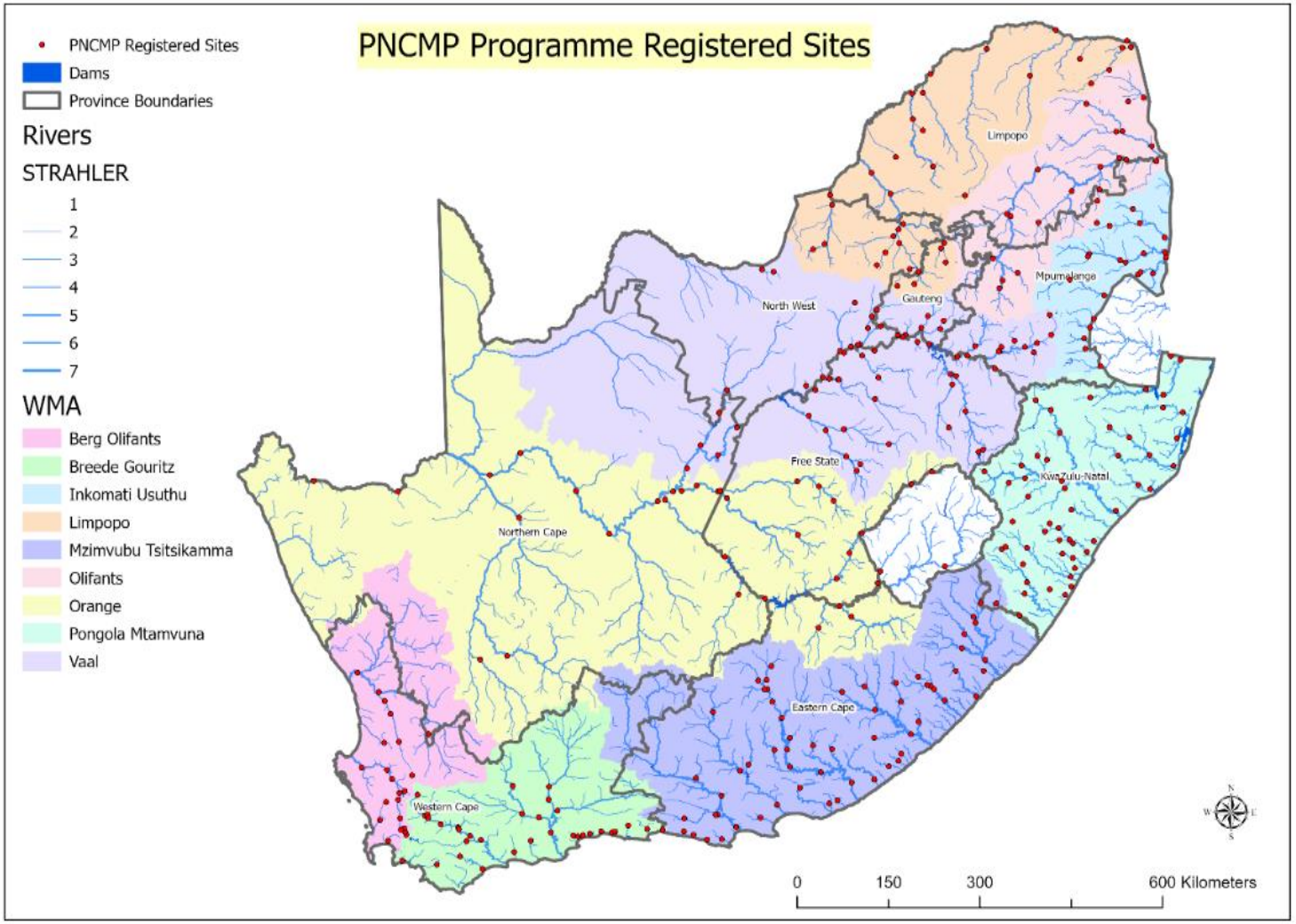


Figure 2.6 : Location of the PNCMP sites across South Africa.

The parameters monitored for the programme include the salinity, which is measured as Total Dissolved Solids (TDS) or Electrical Conductivity (EC), the concentrations of Iron (Fe), Sodium (Na), Chloride (Cl), Magnesium (Mg), Potassium(K), Sulphates (SO_4), Ammonium (NH_4) and Nitrates-nitrites (NO_3 + NO_2). The ammonium and nitrate-nitrite levels indicate nutrient loading from discharges and return flows into water resources. The programme has recently commenced with sampling for trace metal constituents. However, sufficient data is not yet available at this stage.

The sampling compliance at NCMP sites was 15.9% in the 2020/21 hydrological year, but it improved to 42.2% in 2021/22. Compliance dropped slightly to 40.5% for the 2022/23 hydrological year (Figure 2.7). However, it should be emphasised that the fourth quarter of the 2022/23 hydrological year had a dramatically improved 73% sample site visit compliance, owing largely to all parties' more focused sampling efforts (Figure 2.8).

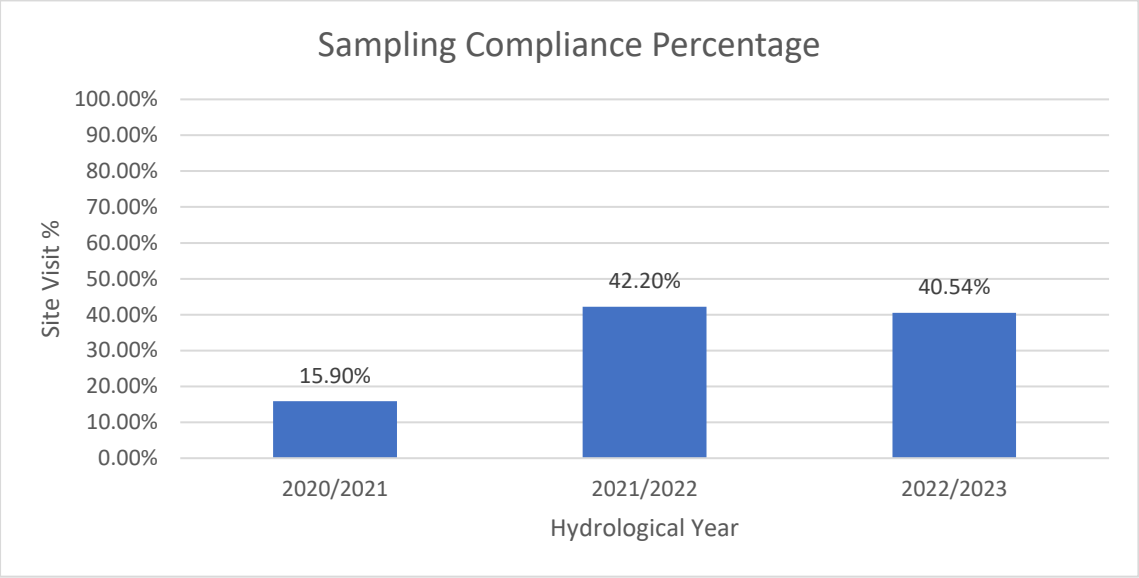


Figure 2.7: Percentage of Priority NCMP sites visited for sampling purposes over the past three hydrological years.

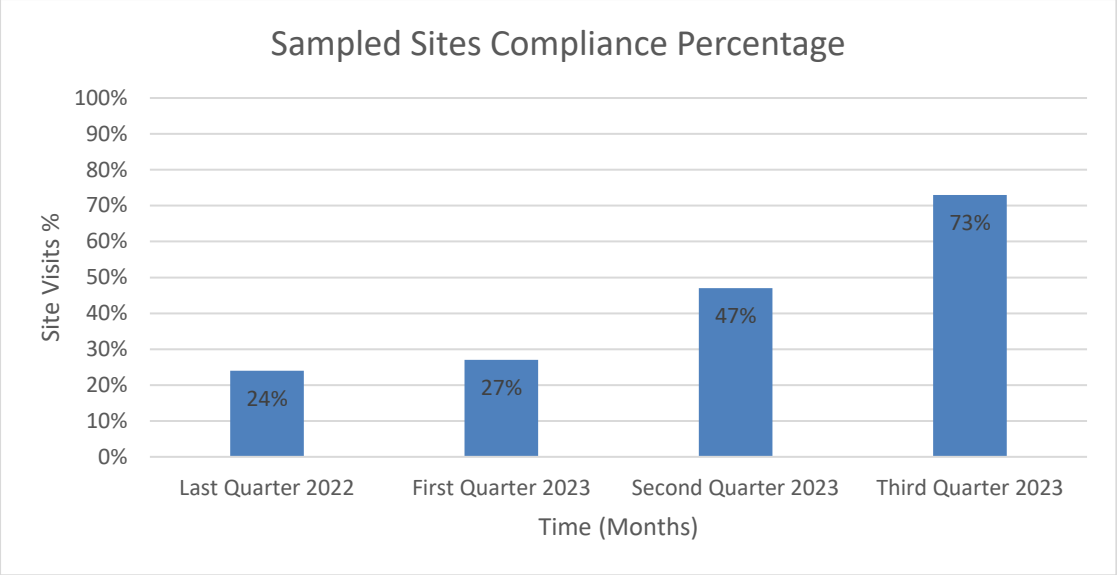


Figure 2.8: Quarterly NCMP sampling performance for the 2022/23 hydrological year.

The NCMP remains highly dependent on Regional Office officials, as well as staff at Water User Associations and Catchment Management Agencies, for sample collection. The laboratories at the Department of Water and Sanitation's Resource Quality Information Services (RQIS) directorate are essential for sample analysis, quality assurance and data capturing into the Water Management System (WMS) database. Sample Reception, a sub-directorate of RQIS is essential for sending out the required supplies to samplers, as well as receiving and logging samples sent to RQIS. These data and other resources are available to the public through the link: https://www.dws.gov.za/iwqs/wms/default.aspx.

2.2.2 National Eutrophication Monitoring Programme (NEMP)

The National Eutrophication Monitoring Programme (NEMP) monitors status and trends in relation to nutrient enrichment of water bodies in South Africa, it was established and officially implemented in 2002. The objective of the NEMP is to measure, assess and report regularly on the current trophic status and the nature of the current eutrophication problems for South African water resources. It also reports on the potential for future changes in the trophic status of dams/lakes and rivers in a manner to support strategic decisions in respect of their national management, being mindful of financial and capacity constraints yet being soundly scientific. The NEMP provides frameworks for addressing the following six (6) objectives for impoundments (dams/lakes) and rivers:

- Establishing trophic status in dams/lakes
- Early warning system – water treatment
- Early warning system – blooms
- Early warning system – invasive macrophytes

- Early warning system – long-term impacts
- Nutrient balance

The programme has over 289 registered sites, including dams, lakes, and rivers. The dam sites are selected based on their strategic importance for the region, country, and international commitments. Sampling is conducted at the dam wall or near the abstraction or discharge point. River sites are mostly selected at points that represent the inflow to the dams monitored.

A total of 119 sites were sampled for NEMP during the 2022/23 hydrological year, similar to the previous hydrological year (Figure 2.9). The provinces which contributed to sampling compliance included Mpumalanga, Free State, Gauteng, Limpopo, Western Cape and North-West. Significant improvements in sampling contribution were noted for Northern Cape and KwaZulu-Natal provinces. Eastern Cape is still lagging behind, and intervention methods are being developed. There were samples collected by DWS partners and stakeholders such as Water boards, Water User Associations, National Parks and Irrigation Boards in the various provinces.

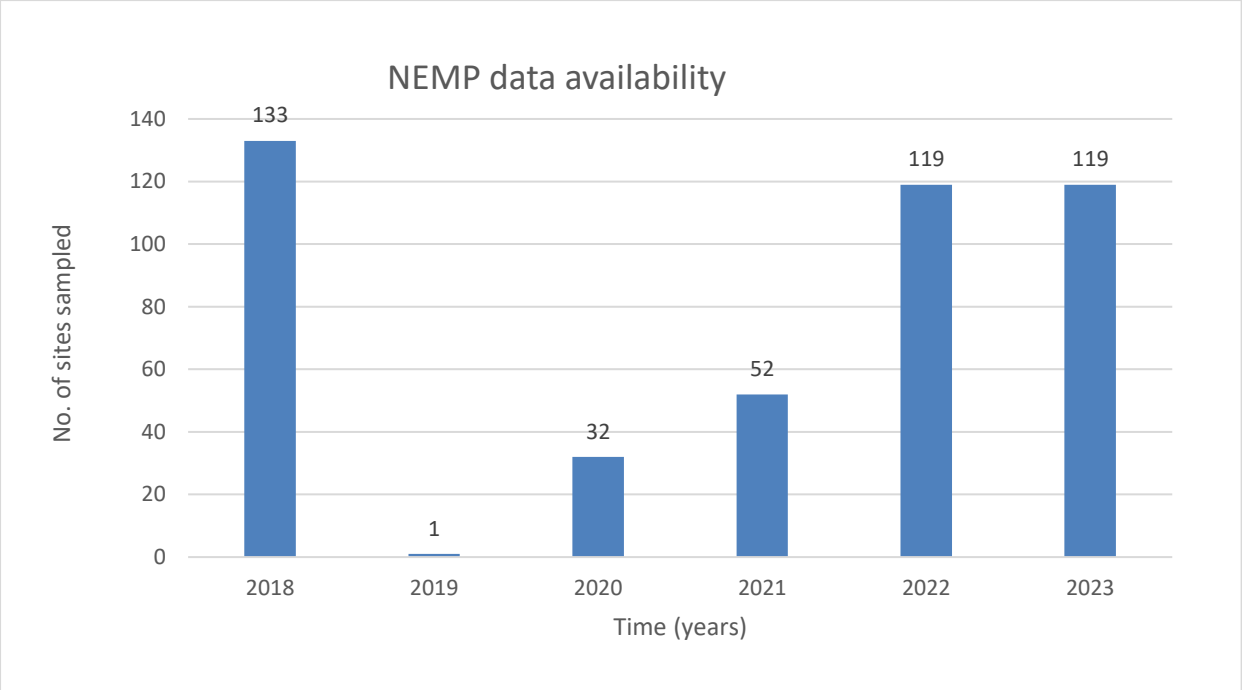


Figure 2.9: NEMP data availability from the year 2018 to 2023.

- *Optimised NEMP sites*

Forty five of the sixty-one dams were monitored during the current reporting period, giving a 74% compliance to the monitoring programme. This is a good baseline for future monitoring of optimised NEMP sites and plans are already underway to further improve this sampling compliance. The distribution of optimised sampling dam sites is depicted in Figure 2.10.

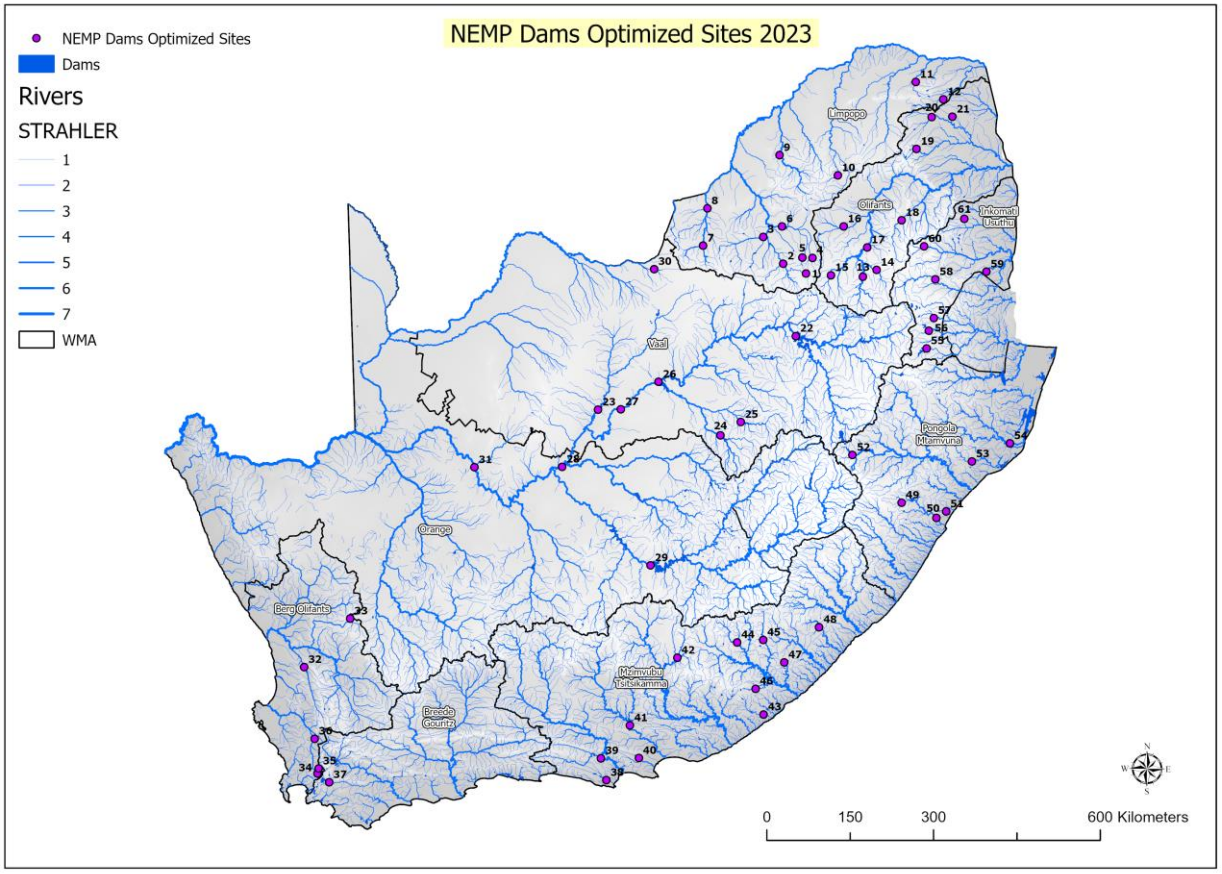


Figure 2.10: Distribution of optimised NEMP sites across the country.

2.2.3 National Microbial Monitoring Programme

The National Microbial Monitoring Programme (NMMP) aims to provide information on the status and trends of the extent of faecal pollution, in terms of the microbial quality of surface water resources in priority areas in South Africa, and to assess the potential health risks to humans associated with the possible use of faecal polluted water resources. The programme was implemented nationwide in the year 2000 to report on the potential health risks associated with faecal pollution of surface water resources at nationally identified hotspots. An indicator bacteria (*E. coli* and or Faecal Coliform) is used to indicate the presence of other pathogens in water or as an indicator of faecal contaminated water. The main objectives of the programme are to:

- Provide information on the status and trends of the extent of faecal pollution, in terms of the microbial quality of surface water resources in high-priority areas, and
- Provide information to help assess the potential health risk to humans associated with the possible use of faecal polluted water resources at those sites.

The programme's primary emphasis is on national hotspots and currently monitors 64 hotspot sites. However, the process of finding new hotspots is already underway. Figure 2.11 illustrates that, beginning in October 2022, the number of active NMMP locations increased from 35 to 52 by September 2023. This development was made possible through collaboration with partners such as eThekwini Municipality, the City of Joburg Municipality, Olifants-Doorn Proto CMA, and the DWS Regional offices. More sites have been identified and will be restored in the Limpopo and Northern Cape regions.

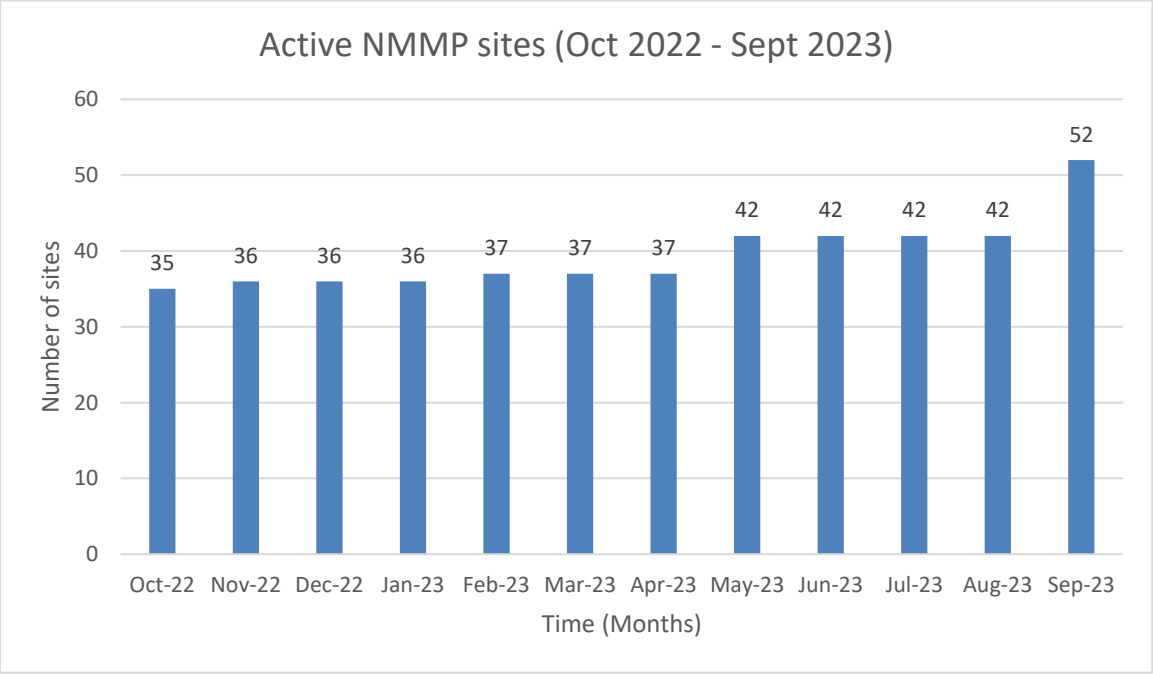


Figure 2.11: Active NMMP sites October 2022 – September 2023

2.2.4 River Eco-Status Monitoring Programme (REMP)

The South African River Health Programme (RHP) was initiated in 1994 in response to the need for more detailed information on the condition of South Africa's River ecosystems. The RHP was initiated prior to the promulgation of the Water Act and as such did not align completely with the Act, so it was later replaced by the River Eco-status Monitoring Programme (REMP). The REMP enables the monitoring of the ecological condition of river ecosystems in South Africa. It provides information regarding the ecological condition of river ecosystems to support the management of rivers and was designed to meet the following objectives:

- Measure, assess, and report the ecological status of river ecosystems;
- Detect and report spatial and temporal trends in the ecological status of river ecosystems;
- Identify and report emerging problems regarding river ecosystems;
- Ensure that all river ecosystem status reports provide scientifically relevant information for the management of these river ecosystems; and

- Create public capacity and environmental awareness.

The REMP is based on existing approved Eco-Status models such as the Index of Habitat Integrity (IHI), Fish Response Assessment Index (FRAI), Macroinvertebrate Response Assessment Index (MIRAI), Vegetation Response Assessment Index (VEGRAI), and Integrated Ecological Condition (Eco-Status), which are used in the ecological conditions assessment at the sub-quaternary reach or site levels. Monitoring is conducted quarterly, and technical reports are issued annually.

Figure 2.12 presents the trends in the REMP sites sampled over the past six years, while Figure 2.13 presents the spatial distribution of the REMP sites across the country. The number of sites per reporting year increased from 207 in 2016/17 to 506 in 2021/22. The COVID-19 restrictions caused a decrease in the number of sites monitored from 2019 to 2020.

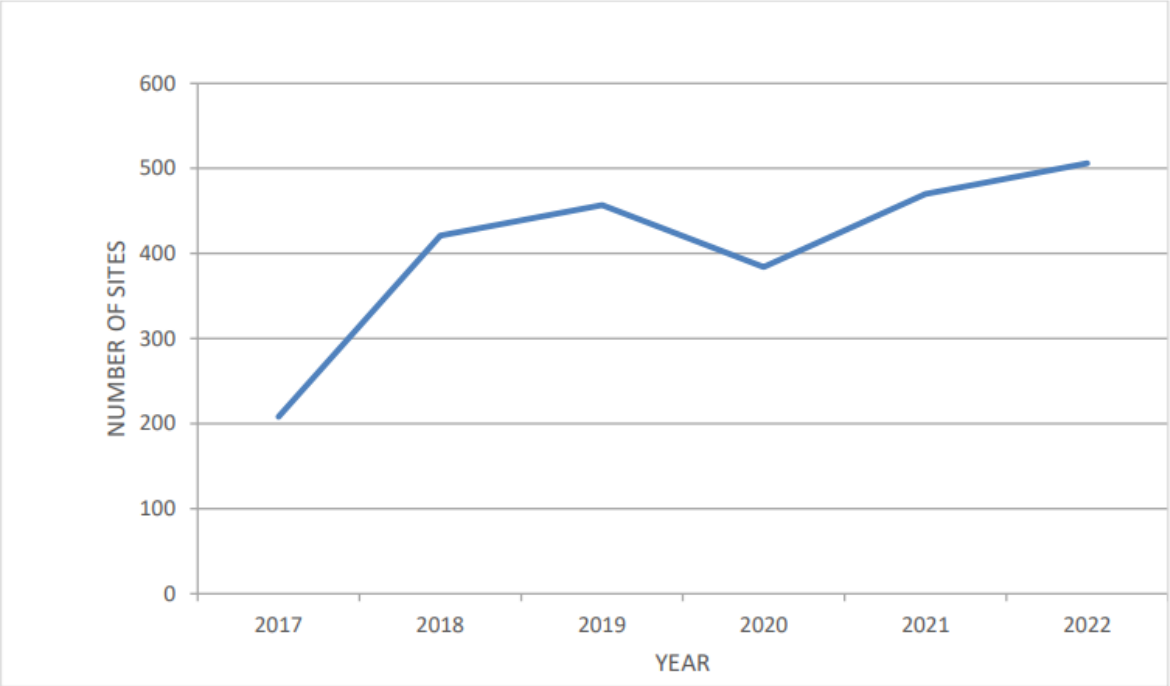


Figure 2.12: Trends of REMP sites monitored over the years.

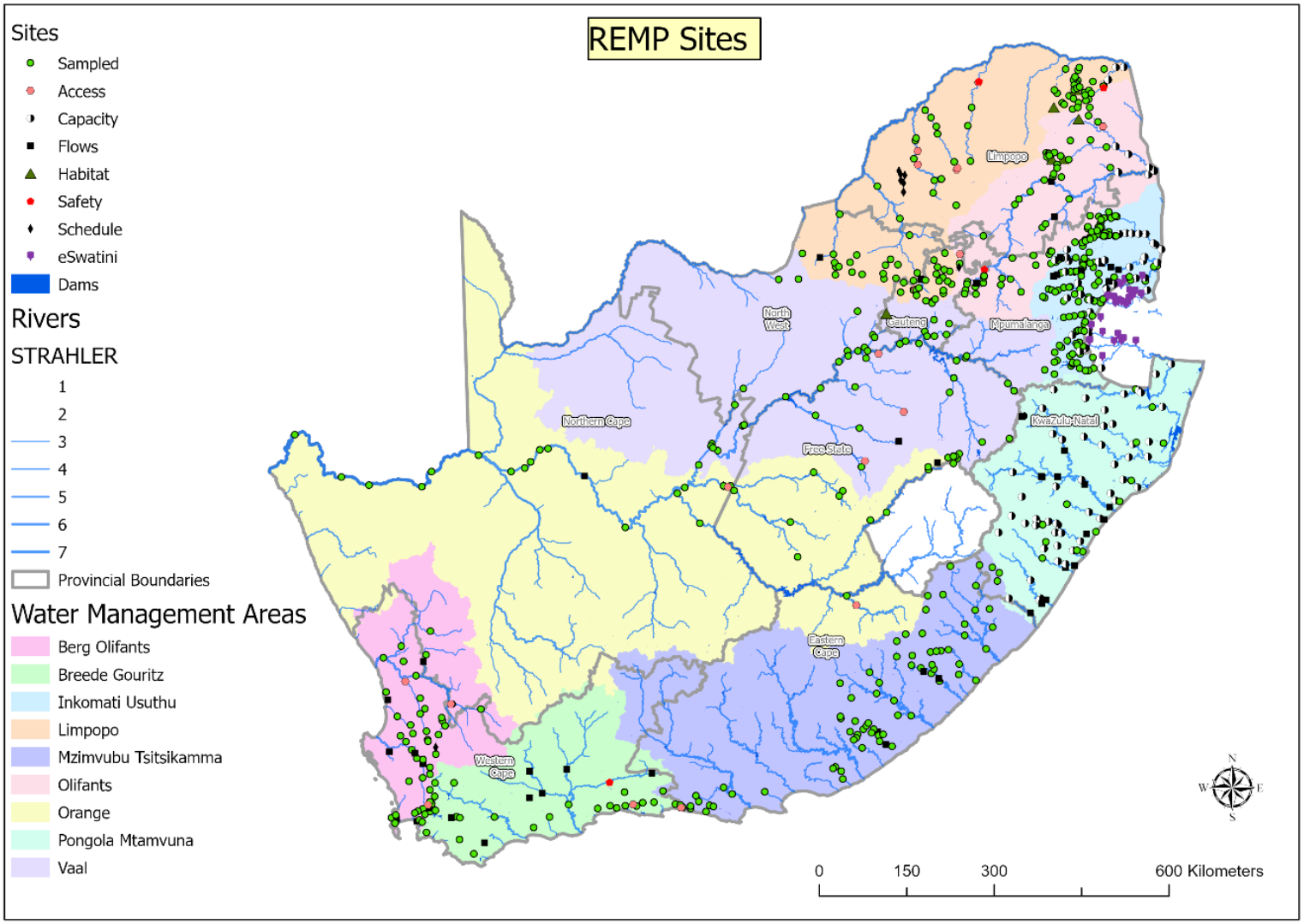


Figure 2.13: Distribution of REMP sites- 2021/22 hydrological year.

2.3 Groundwater Monitoring

The DWS Groundwater Monitoring programme is divided into two programmes which are groundwater quality monitoring and groundwater level monitoring (Figure 2.14). The Groundwater Quality Monitoring Programme comprises two sub-programmes, the National Groundwater Quality Monitoring also known as ZQM Programme and the Acid Mine Drainage (AMD) Special monitoring programme covering managed by the National Office at the Cradle of Humankind World Heritage Site (CoH-WHS) and Dundee. The Groundwater Level Monitoring programme also comprises two sub-programmes, the combined groundwater level networks managed by the Regional Offices and Catchment Management Agencies (CMA), and the AMD Special Monitoring programme which is managed by the National Office.

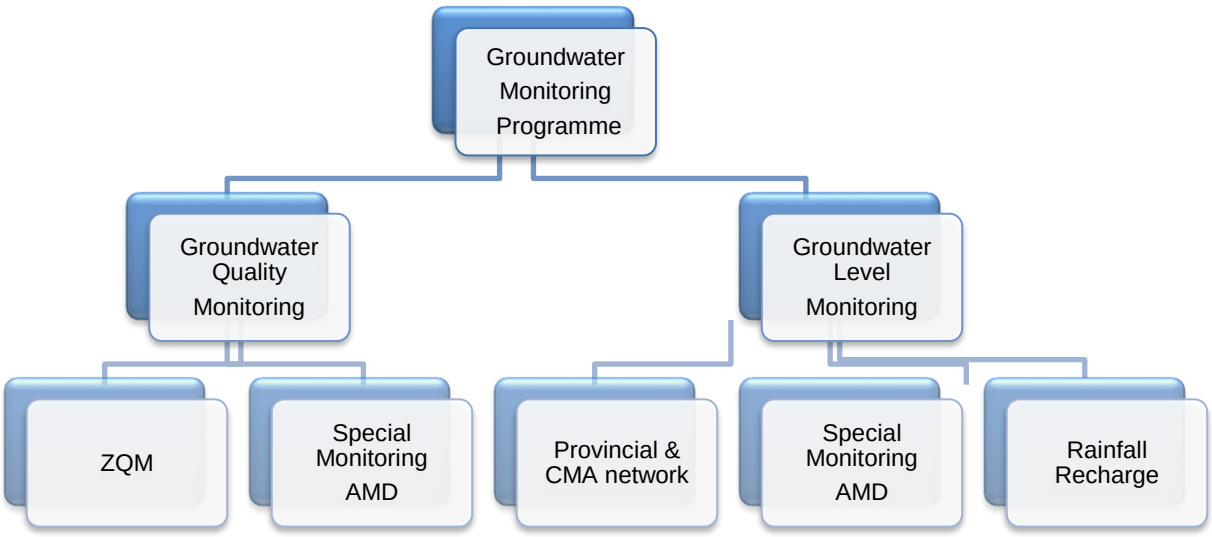
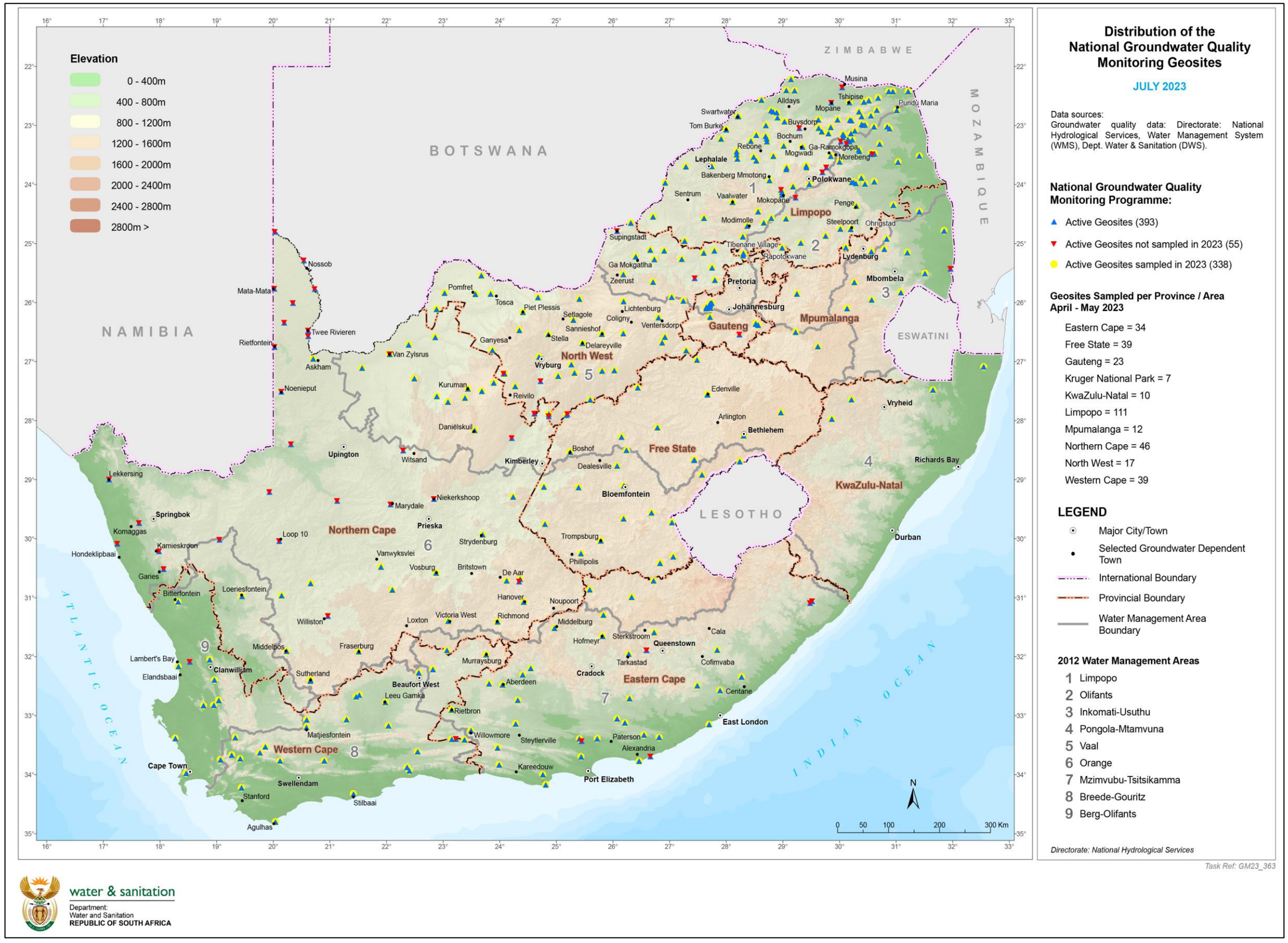


Figure 2.14 Groundwater Monitoring Programmes

2.3.1 Groundwater Quality Monitoring Programmes

The Groundwater Quality Monitoring (ZQM) Programme was established in 1994. The objectives of the ZQM programme are to investigate the influence of rainfall on groundwater quality; to determine the state of groundwater quality nationally; and observe groundwater quality trends. The ZQM programme has 420 groundwater quality stations, monitoring chemical and physical parameters across the country. The monitoring stations are distributed in strategic locations such as Schools, Clinics, Farms, Hospitals, Community Supply etc. The spatial distribution of the ZQM sites based on April/May monitoring run is presented in Figure 2.15.



Distribution of the National Groundwater Quality Monitoring Geosites

JULY 2023

Data sources:
Groundwater quality data: Directorate: National Hydrological Services, Water Management System (WMS), Dept. Water & Sanitation (DWS).

National Groundwater Quality Monitoring Programme:

- Active Geosites (393)
- Active Geosites not sampled in 2023 (55)
- Active Geosites sampled in 2023 (338)

Geosites Sampled per Province / Area April - May 2023

- Eastern Cape = 34
- Free State = 39
- Gauteng = 23
- Kruger National Park = 7
- KwaZulu-Natal = 10
- Limpopo = 111
- Mpumalanga = 12
- Northern Cape = 46
- North West = 17
- Western Cape = 39

LEGEND

- Major City/Town
- Selected Groundwater Dependent Town
- International Boundary
- Provincial Boundary
- Water Management Area Boundary

2012 Water Management Areas

1. Limpopo
2. Olifants
3. Inkomati-Usuthu
4. Pongola-Mtamvuna
5. Vaal
6. Orange
7. Mzimvubu-Tsitsikamma
8. Breede-Gouritz
9. Berg-Olifants

Directorate: National Hydrological Services

Task Ref: GM23_363

water & sanitation
Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

Figure 2.15: The National Groundwater Quality Monitoring network – July 2023.

The AMD special programme at CoH-WHS was established in 2012. It has 24 monitoring stations, and the frequency is four times a year. The objective of the AMD special programme at CoH-WHS is to evaluate the hydrochemical impact of historical mining activities around CoH-WHS property. Monitoring is a collaboration between the Council for Scientific and Industrial Research (CSIR) and the Gauteng provincial office.

The AMD special programme at Dundee was established in 2011. The objective of the AMD special programme at Dundee is to evaluate the impact of defunct coal mines on the local water resource, within the Sandspruit catchment.

2.3.2 Groundwater Quality Data Availability

Groundwater quality and groundwater levels are usually conducted for at least the end of the wet season (Apr / May) and end of the dry season (sept/Oct) for most parts across the country. During the Sep/Oct 2022 and Apr/May 2023 sampling runs, 240 (57%), and 243 (58%) monitoring sites were sampled and analysed, respectively (Figure 2.16). This data including data from the AMD special programmes is available on WMS on request. Groundwater quality data is publicly available through a data request, which can be sent to: georequests@dws.gov.za.

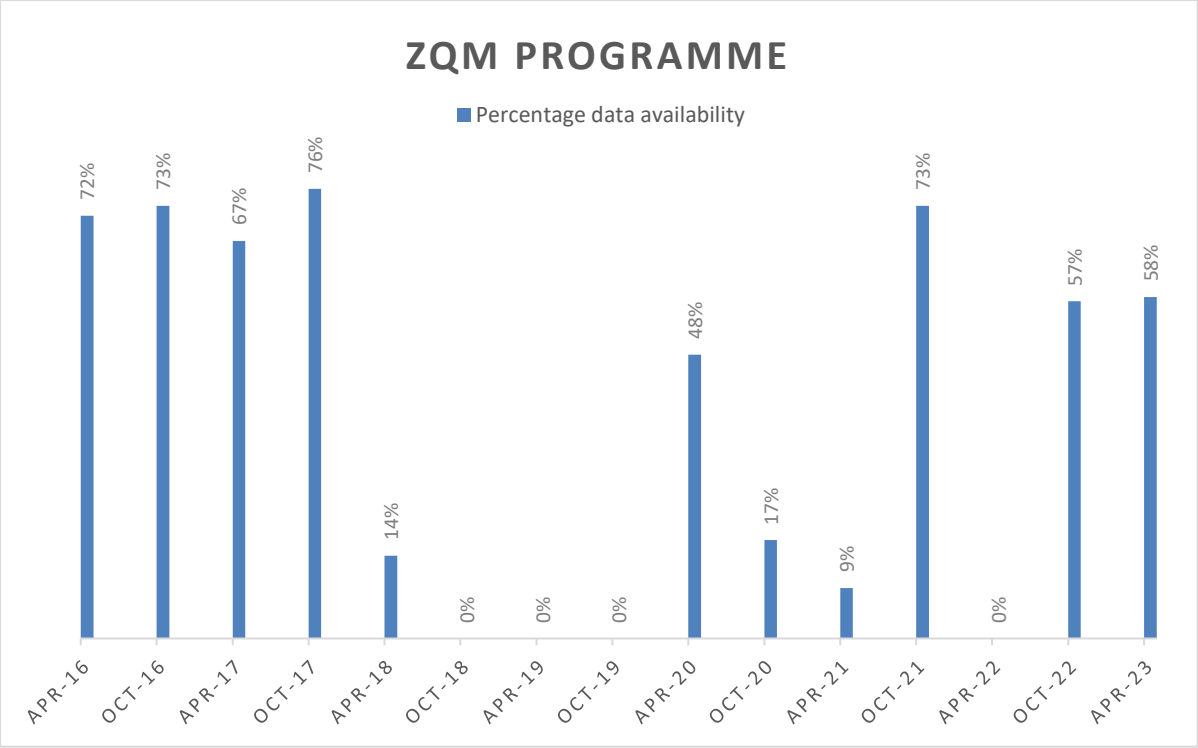


Figure 2.16: ZQM programme data availability on WMS from 2016 to 2023 as of January 2024.

2.3.3 Groundwater Level Monitoring

As of 30 September 2023, there are 6 273 (57 AMD) registered groundwater level monitoring sites, however, only 1 744 sites are active. The frequency of groundwater level data collection for sites per Provincial Office is summarised in Table 2-1. The monitoring frequencies vary from monthly, every two months, and quarterly. The most common frequency is quarterly at 74%, followed by monthly at 14% dominated by KZN, MP and FS. Gauteng province monitoring frequency is mainly 2-monthly at 98%.

Out of the 1 744 active monitoring sites, 1 361 sites are monitored manually with a dip meter, while 375 sites are equipped with electronic data loggers. Groundwater level data is collected and uploaded onto the HYDSTRA database system where it can be extracted for analysis.

Table 2-1: Groundwater level monitoring frequency per region.

Region	Frequency			
	Monthly	**2-Monthly**	**Quarterly**	**Other**
WC	6%	7%	87%	
EC	4%		96%	1%
KZN	96%			4%
GP	2%	98%		
MP	67%		26%	7%
FS	100%			
NC			100%	
LP			93%	7%
NW	6%		94%	
AMD	89%		9%	2%
Total	**14%**	**10%**	**74%**	**1%**

*Special programme

2.3.4 Groundwater Level Data Availability

The total groundwater level data available on HYDSTRA is 1 481 (85%) for HY2022/23 (Figure 2.17 and Table 2-2). The spatial distribution of active monitoring sites is presented in Figure 2.18. Groundwater level monitoring data is publicly available through a data request, which can be sent to: georequests@dws.gov.za.

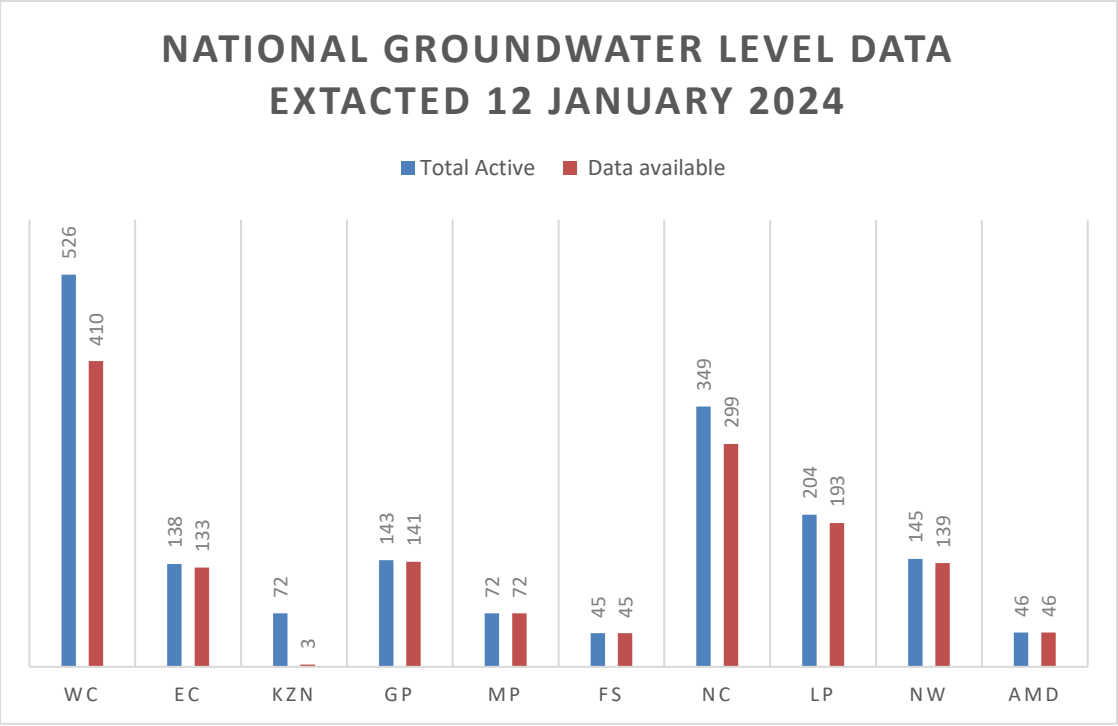
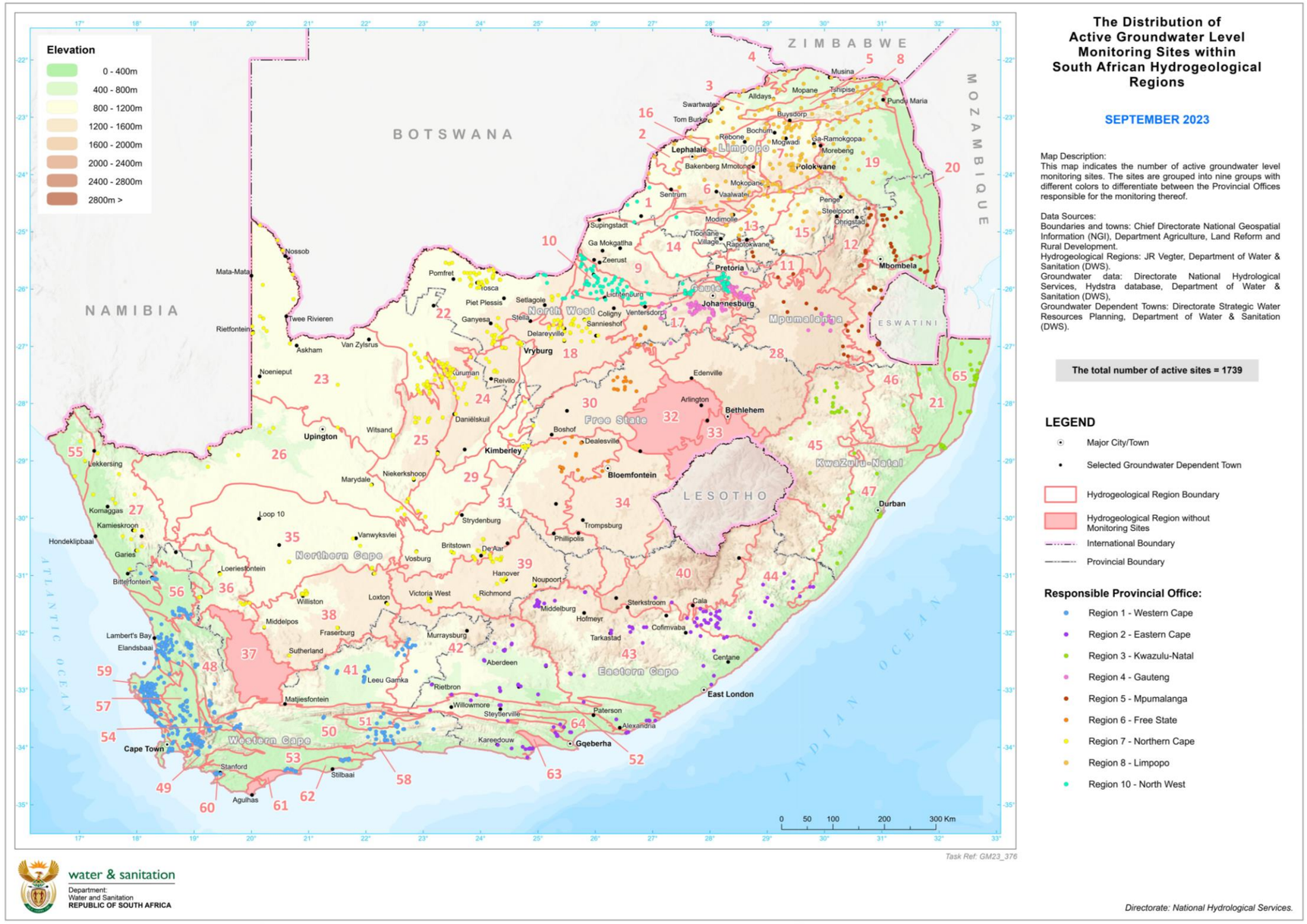


Figure 2.17: Groundwater data availability on HYDSTRA per region for 2023 (as of 12 January 2024)



The Distribution of Active Groundwater Level Monitoring Sites within South African Hydrogeological Regions

SEPTEMBER 2023

Map Description:
This map indicates the number of active groundwater level monitoring sites. The sites are grouped into nine groups with different colors to differentiate between the Provincial Offices responsible for the monitoring thereof.

Data Sources:
Boundaries and towns: Chief Directorate National Geospatial Information (NGI), Department Agriculture, Land Reform and Rural Development.
Hydrogeological Regions: JR Vegter, Department of Water & Sanitation (DWS).
Groundwater data: Directorate National Hydrological Services, Hydstra database, Department of Water & Sanitation (DWS),
Groundwater Dependent Towns: Directorate Strategic Water Resources Planning, Department of Water & Sanitation (DWS).

The total number of active sites = 1739

LEGEND

- Major City/Town
- Selected Groundwater Dependent Town
- Hydrogeological Region Boundary
- Hydrogeological Region without Monitoring Sites
- International Boundary
- Provincial Boundary

Responsible Provincial Office:

- Region 1 - Western Cape
- Region 2 - Eastern Cape
- Region 3 - Kwazulu-Natal
- Region 4 - Gauteng
- Region 5 - Mpumalanga
- Region 6 - Free State
- Region 7 - Northern Cape
- Region 8 - Limpopo
- Region 10 - North West

REGION ID	REGION NAME
4	Limpopo Karoo Basin
3	Limpopo Granulite Gneiss Belt
5	Soutpansberg Hinterland
20	Northern Lebombo
8	Soutpansberg
19	Lowveld
7	Pietersburg Plateau
6	Waterberg Plateau
2	Waterberg Coal Basin
16	Northern Bushveld Complex
12	Eastern Bankeveld
1	Makoppa Dome
15	Eastern Bushveld Complex
13	Springbok Flats
9	Western Bankeveld and Marico Bushveld
14	Western Bushveld Complex
23	Western Kalahari
22	Eastern Kalahari
10	Karst Belt
46	Northeastern Middleveld
11	Middelburg Basin
17	Central Highveld
24	Ghaap Plateau
21	Southern Lebombo
65	Northern Zululand Coastal Plain
29	Dry Harts-Lower Vaal-Orange Lowland
25	West Griqua Land
45	Northwestern Middleveld
26	Bushmanland
27	Namaqualand
55	Richtersveld
47	Kwazulu-Natal Coastal Foreland
35	Bushmanland Pan Belt
44	Transkeian Coastal Foreland and Middleveld
39	Eastern Upper Karoo
40	Southeastern Highland
36	Hantam
56	Knersvlaktie
38	Western Upper Karoo
43	Ciskeian Coastal Foreland and Middleveld
42	Eastern Great Karoo
37	Tanqua Karoo
48	Northwestern Cape Ranges
41	Western Great Karoo
59	Southwestern Coastal Sandveld
57	Swartland
52	Grootrivier-Klein Winterhoek-Suur-Kaprivier Ranges
50	Southern Cape Ranges
54	Intermontane Tulbagh-Ashton Valley
49	Southwestern Cape Ranges
64	Algoa Basin
51	Oudtshoorn Basin
63	Lower Gamtoos Valley
53	Ruensveld
58	Outenikiwa Coastal Foreland
62	Stilbaai Coastal Belt
61	Bredasdorp Coastal Belt
60	Die Kelders Embayment
18	Western Highveld
28	Eastern Highveld
30	Northeastern Pan Belt
32	Southern Highveld
33	Northern Highland
31	Central Pan Belt
34	Northeastern Upper Karoo

Figure 2.18: Active groundwater level monitoring sites - September 2023.

Table 2-2:Groundwater Level Monitoring Data availability

STATUS OF THE AVAILABILITY OF GROUNDWATER LEVEL MONITORING DATA ON HYDSTRA AS ON 12 JANUARY 2024						
		Total Registered Sites	**Total NOT Active Sites**	**Total Active Sites**	**Total Active Sites with data as on 12 January 2024**	**Total Active Sites with available data as on 12 January 2024 (%)**
		6 273	**4 529**	**1 744**	**1 481**	**85%**
Monitoring Groundwater Level: Variable 110.00, 110.40				**(Extracted on 12 January 2024 from HYDSTRA)**		
Responsible Regional Office		**Total Registered Sites**	**Total NOT Active Sites**	**Total Active Sites per Region**	**Active Sites with available data as on 12 January 2024**	**Active Sites with available data as on 12 January 2024 (%)**
1	Western Cape	1 678	1 152	526	410	78%
2	Eastern Cape	333	196	137	133	97%
3	KZN	134	62	72	3	4%
4	Gauteng	800	653	147	141	96%
5	Mpumalanga	119	47	72	72	100%
6	Free State	167	122	45	45	100%
7	Northern Cape	1 861	1 512	349	299	86%
8	Limpopo	598	393	205	193	94%
10	North-West	526	381	145	139	96%
AMD	National Office	57	11	46	46	100%

2.4 National Integrated Water Information System

The National Integrated Water Information System (NIWIS) was conceptualised to meet the objective of serving as a single extensive, integrated, accessible national water information system to fulfil the mandate of both the National Water Act (No. 36 of 1998; Chapter 14, Sections 137 to 145), as well as the National Water Services Act (No 108 of 1997; Chapter 10, Sections 67, 68 & 69). Effective 01 September 2015, NIWIS went live with 43 dashboards that were developed and implemented (Figure 2.19). Ever since NIWIS has been experiencing enormous growth through enhancements responding to ever-growing business information requirements, NIWIS is an information system intended to provide information to researchers, water managers, and the public at large, and this system can be accessed at https://www.dws.gov.za/niwis2.

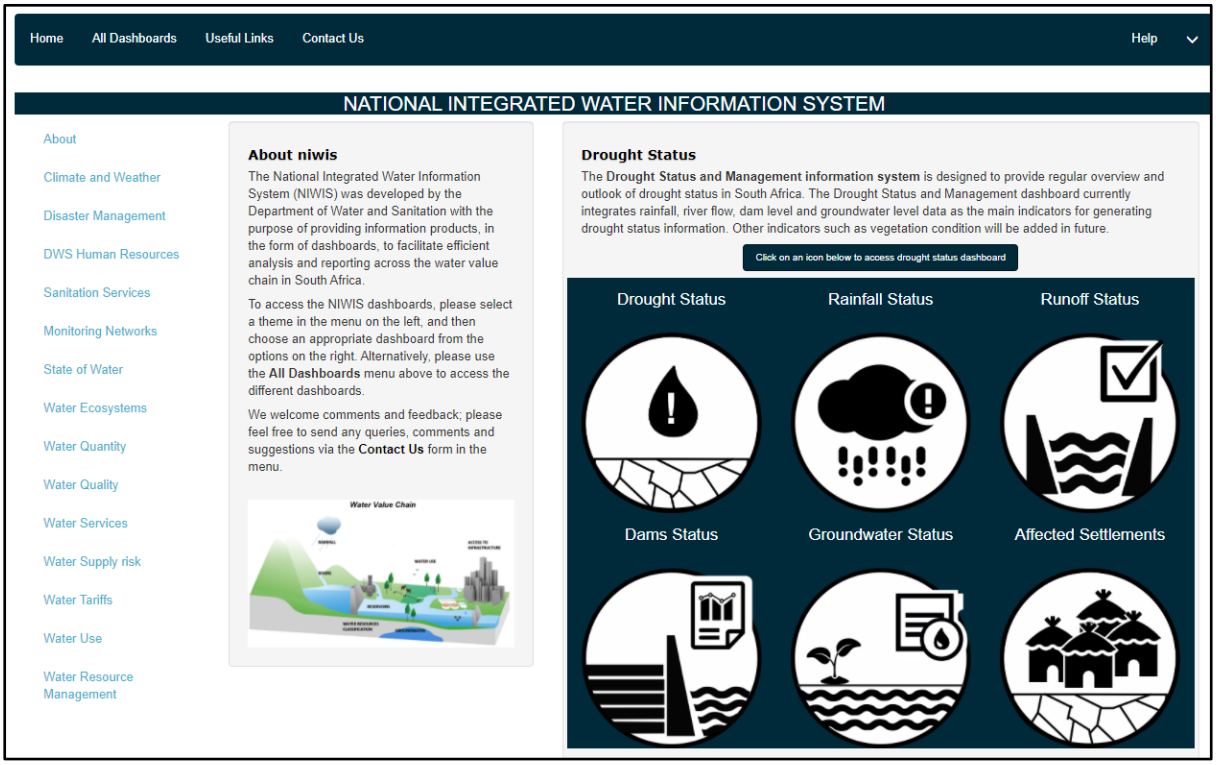


Figure 2.19 NIWIS landing page (https://www.dws.gov.za/niwis2/)

NIWIS allows for user customisation and is convenient. It has since become one of the Department's strategic investment tools, which ensures that information on the sector is readily available and conveniently disseminated. However, the system is currently experiencing challenges, where the automation has been taking place at a business level, not at a Departmental level, which has resulted in many parallel systems that are not complementing one another, albeit sharing the same client or water information in some cases. However, there are further developments of NIWIS in progress despite these challenges.